MAPPING SYSTEM FOR THE INTEGRATION AND GRAPHICAL DISPLAY OF PIPELINE INFORMATION THAT ENABLES AUTOMATED PIPELINE SURVEILLANCE

CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

Not applicable.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a pipeline mapping system for comparing and graphically displaying integrated pipeline information without the need for ongoing, periodic aerial surveillance.

2. Description of the Related Art

Pipelines are widely used in a variety of industries and allow material to be transported from one location to another. A variety of fluids such as oil, gas, particulates, and other small solids suspended in fluids are transported using pipelines. In a typical application a pipeline carries a large quantity of oil products under pressure. Frequently, pipelines carry these products at high temperature and at high flow rates. Many pipelines are also routed through environments and carry products that affect the vitality of the pipeline. Environmental factors or transported products may result in, among other things, pipeline corrosion.

Pipeline corrosion, if not detected and remedied, can result in release of a pipeline's contents into a surrounding environment. Soil subsidence, local construction projects, seismic activity, weather, and degradation caused by normal use can also lead to defects and anomalies in a pipeline. In addition, harsh environments can cause pipelines to move gradually over time thus making later detection of buried pipelines difficult. These shifts in the pipeline location can also lead to defects, cracks, leaks, bumps, and other anomalies in the pipeline.

The internal and external surface walls of a pipeline are susceptible to damage by various factors. These factors may include: reactivity to the material flowing through the pipeline; pressure, temperature and chemical characteristics of various products and contaminants inside and outside the pipeline; corrosion; mechanical damage; fatigue; cracks; stress; distortion due to dents or wrinkles; exposure; and damage due to weight coating and free spanning of offshore pipelines. Moreover, submarine pipelines face additional hazards which include ship anchors, troll boards, and seabed scouring due to strong currents. While timely repair or maintenance of pipelines can lengthen the service lifetime of the pipeline, a rupture or serious leak within the pipeline can be difficult and expensive to repair. Further, in the early stages the exact position of the rupture may be difficult to locate.

The identification and location of defects and anomalies is crucial to pipeline maintenance. Identifying these faults in a buried pipeline is problematic when the location of the buried pipeline cannot be readily ascertained. As previously stated, many of the environmental stresses on the pipeline that cause defects and anomalies to appear in the pipeline can also shift the pipeline location. This is particularly true of very long pipelines.

Traditionally, pipeline operators have used various surveillance techniques to check for pipeline defects and encroachment. One such technique has involved aerial surveillance (utilizing an airplane or helicopter) to check for pipeline defects and encroachments. A disadvantage of aerial surveillance arises from its cost and concern for the safety of the persons performing the aerial surveillance. Another, less widely used surveillance technique has involved a person traversing a pipeline. The cost of this technique in terms of personnel and time is very high.

In addition to surveillance, traversing (or walking) a pipeline has also been used to locate or map the pipeline. When mapping a pipeline by traversing the pipeline route, a survey crew located the pipeline and took numerous global positioning system (GPS) readings along the pipeline route. These GPS coordinates were then stored for later display or visualization of the pipeline route. Again, pipeline survey crews were expensive and the task was time consuming.

Satellite and airborne imaging systems have also been utilized for various mapping tasks. Satellite imaging systems have been available for a number of years, but high resolution images have not been commercially available. High resolution images provided by such satellite imaging systems can provide information that can be useful in geographical mapping. One such satellite system with the capability of providing high resolution images is known as very high resolution (VHR) satellite imagery. VHR satellite imagery is scheduled to soon be available from a growing number of such satellites. The information contained within VHR satellite imagery is known to have a spatial resolution of approximately 1 meter.

Various geographic information system (GIS) software packages are commercially available for viewing images. One such package is IMAGINE®, a product of the Erdas Corporation based in Atlanta, Ga., which provides a Windows based image analysis and processing package. IMAGINE® provides for visual analysis of data and is capable of displaying, geo-correcting, and reprojecting that data.

Software packages that are directed to the presentation of pipeline inspection information are known and commercially available. One such package is PipeVision, a product of Pipeline Integrity International Ltd., assignee of the present invention. PipeVision presents existing pipeline inspection information in graphical and report formats.

SUMMARY OF THE INVENTION

The present invention provides a technique that utilizes pipeline data and satellite data for surveying or providing surveillance for a pipeline. The satellite data is integrated with the pipeline data to produce a current pipeline map. The current pipeline map can then be compared with a previous pipeline map to determine whether the route of the pipeline or a surrounding environment of the pipeline has changed. In a disclosed embodiment, the satellite data is very high resolution (VHR) satellite imagery and the pipeline data includes location data that is a series of global positioning system (GPS) coordinates.

Pipeline data from several sources, can also be integrated. The present invention provides for automated pipeline surveillance without requiring routine, periodic surveillance from an airplane or helicopter traversing the pipeline route. This reduces surveillance costs and alleviates safety concerns for those persons performing the aerial surveillance.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention can be obtained when the following detailed description of the